



Fracture Characterization of Meteorites



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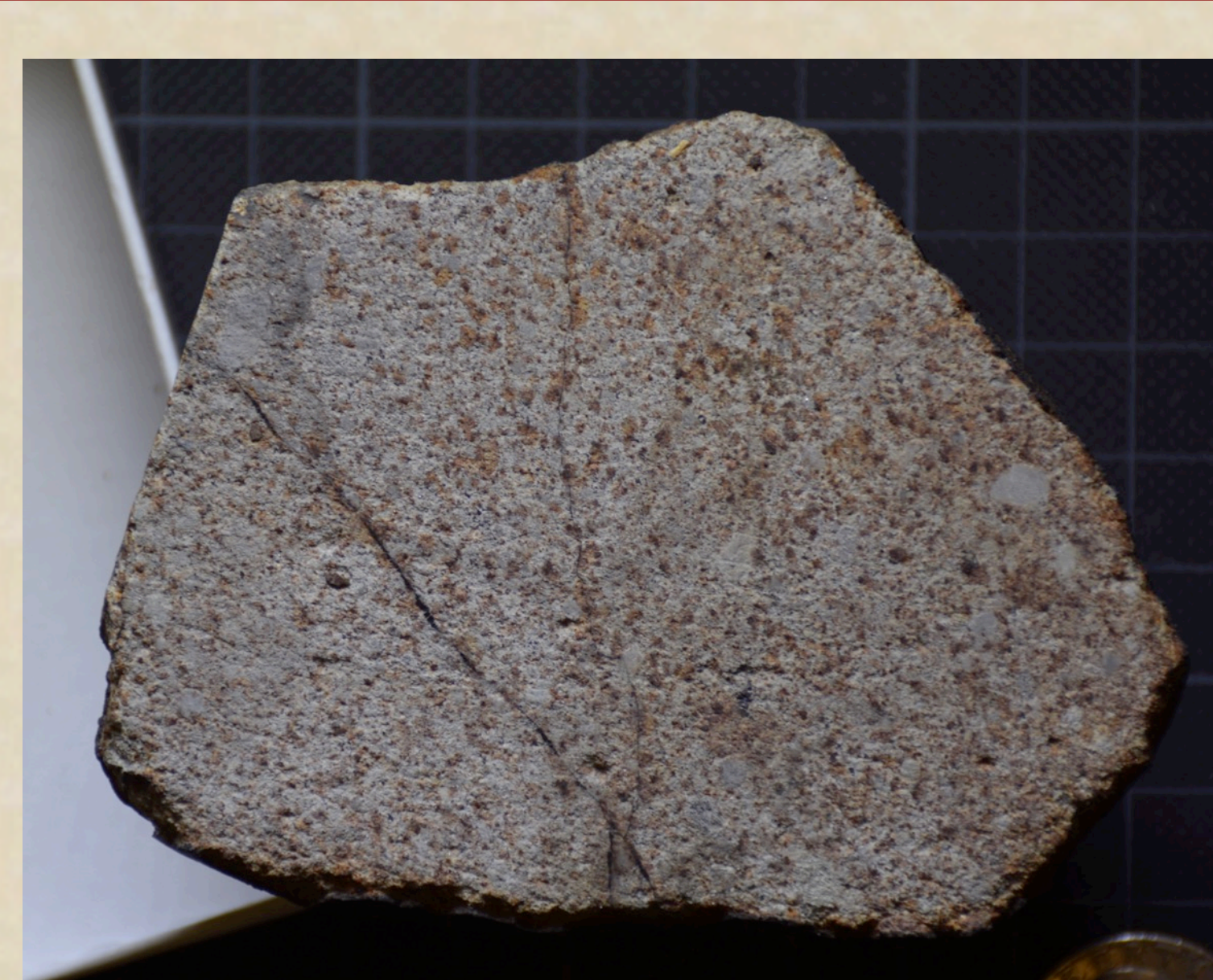
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INTRODUCTION

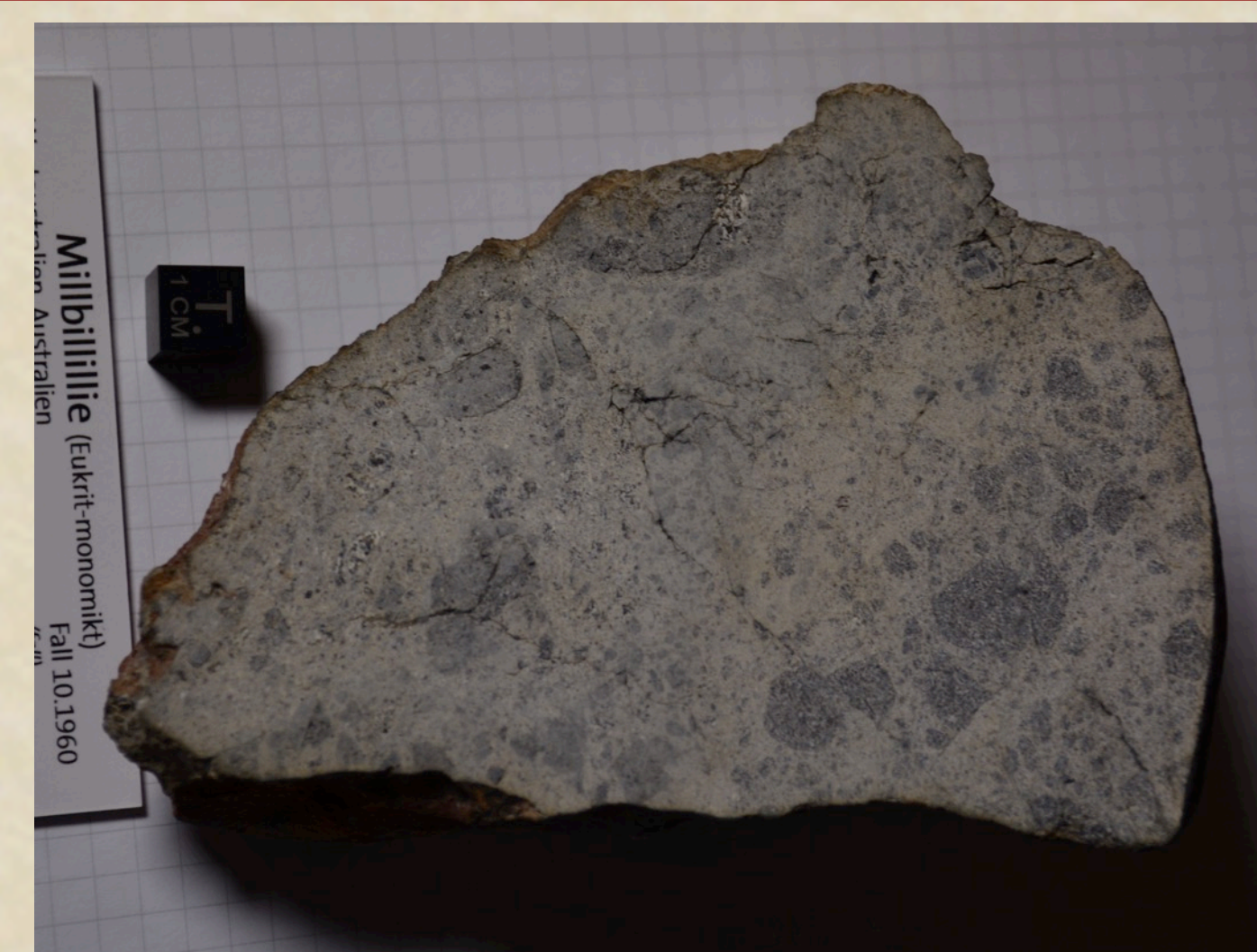
- We are attempting to understand the behavior of asteroids entering the atmosphere and with describing their diverse fracture processes as part of an effort to understand their atmospheric passage and impact hazard
- Among the uncertainties required for this task are the physical properties of the incoming objects [1] and their fracture mechanics [2,3]
- Strength of meteorites plays an important role in determining the outcome of impact events in which a meteorite is the impactor [4]
- Meteorites come from the surfaces of asteroids and their physical properties are determined to a large extent by the cratered history of the source asteroid (see central figure)
- Meteorites in the Natural History Museums, Vienna (all classes) and London (L & H chondrites) were examined, and fracture patterns in selected individuals were imaged



Coarse irons like Canyon Diablo, fractured along kamacite grain boundaries (Natural History Museum, Vienna, G8357)



Some L and H Chondrites have thin veins, with a point of weakness, e.g. Chandpur (Natural History Museum, London)



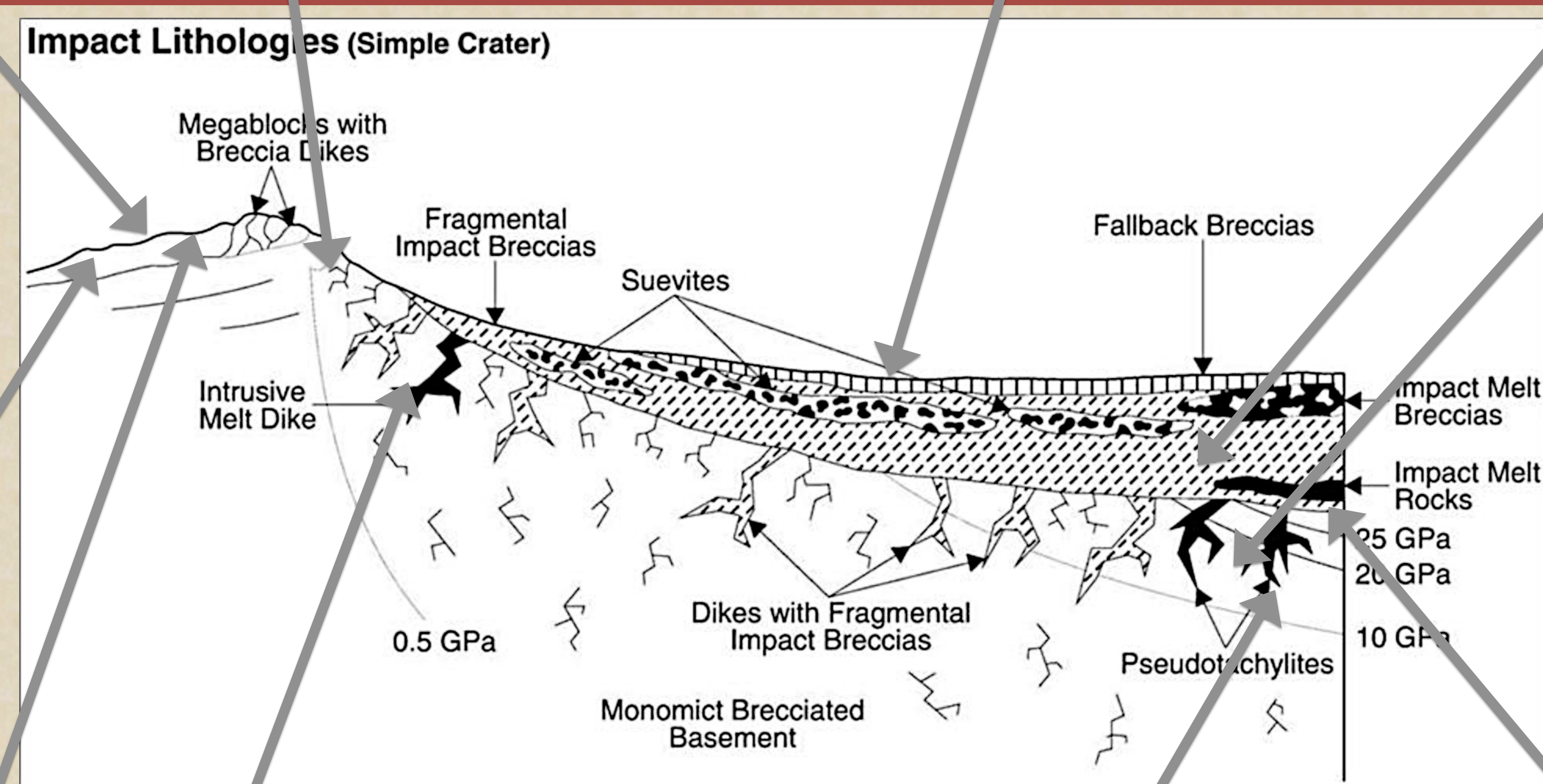
Millbillillie (Natural History Museum, Vienna M2289)



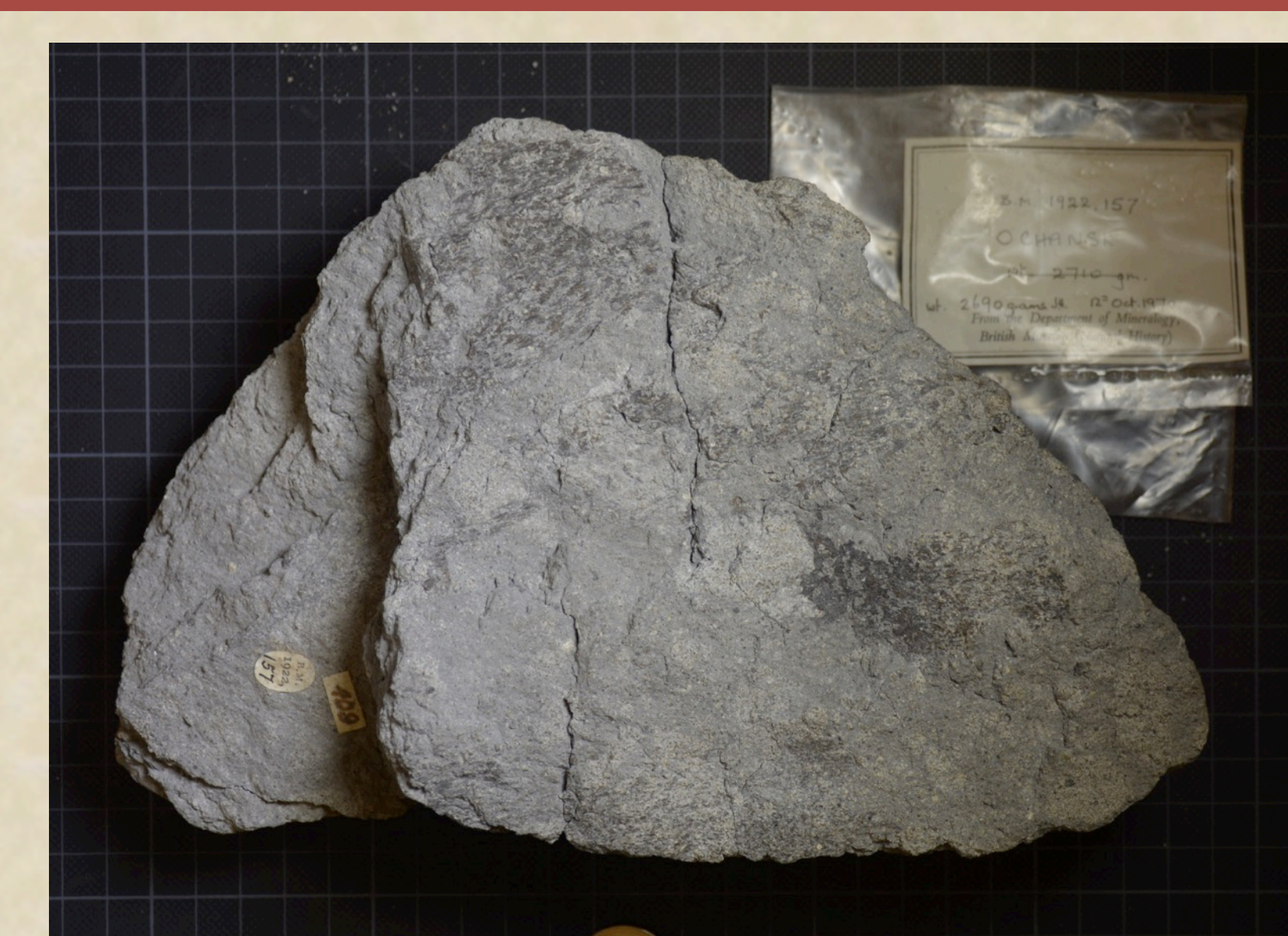
Occasionally veins in L and H Chondrites have brick-wall networks, like this piece of Futtehpur (Natural History Museum, London).



Fine irons with large crystal boundaries, like Arispe, fragmented along the crystal boundaries (Natural History Museum, Vienna, H2006)



Source: Koeberl, C., 1997 [5]



Ochansk, fragments were heavily fractured and highly friable with fractures running parallel to frontal fusion crust producing blocky pieces. A feature in the sample appears to look similar to a shatter cone. (Natural History Museum, London)



Fine irons like Coahuila, fragmented randomly (Natural History Museum, Vienna, C3295)



Bluff contains distinct glass melt veins (Natural History Museum, London).



Pacur with its highly veined networks (Natural History Museum, Vienna, F4326).



Pervomaisky contains one of these thin veins, along with a shock blacked region (Natural History Museum, London)

CONCLUSIONS

- Certain fracture mechanisms dominate, for a given class of meteorite (Coarse Irons –along kamacite grain boundaries, Fine irons with large crystals – along crystal boundaries, Fine irons – fragmented randomly, Ordinary chondrites – most thin veins with no obvious orientation, Others have thin veins with a point of weakness, and Occasionally brick-work patterns).
- Considerable variation within class expected
- Our next tasks will be: (1) Further understand the mechanisms of various types of fractures, (2) Model them numerically, and (3) Investigating how these fractures scale to their parent asteroids

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References: [1] Ostrowski et al., this volume. [2] Baldwin B. and Sheaffer Y., 1971. Jour. Geophys. Res. 76:4653-4668. [3] Popova O. et al. 2011. Meteorit. Planet. Sci. 46:1525-1550. [4] Agrawal, P. et al. 2015. Planetary Defence Workshop [5] Koeberl, C., 1997. Oklahoma Geological Survey Circular 100, 30-54.